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GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS
IN WESTERN COLORADO, USING SKYLAB EREP DATA

Monthly Progress Report

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INTRODUCTION

The primary objective of the CSM Skylab Program is to analyze EREP data for geologic information. To this end, the research has been subdivided into the following tasks;

- Task I. The PI shall assist NASA/MSC in mission planning activities related to the proposed investigation.
- Task II. The investigator will screen all EREP data obtained over Colorado and will select frames for detailed study.
- Task III. The investigator will prepare photogeologic maps using selected S-190 photographs, and will analyze them to determine what geologic information may be contained in them.
- Task IV. The geological interpretations obtained in Task 3 will be compared to interpretations obtained from S-192 imagery, and to interpretations made from ERTS-I imagery.
- Task V. The geological interpretations will be verified by means of interpretation of aerial photographs, published geological reports, and field observations.
- Task VI. The investigator will prepare recommendations for the optimum type, scale, and resolution of imagery to be used for studies of regional geology and exploration for mineral deposits and water resources.

PROGRESS

Overall Status

With this report, Milestones 1 through 12 have been achieved, with the exception of Milestone 10.

Past Month's Activities

Work continued on the compilation of the Bonanza Test Site geologic map. The compilation is now essentially complete, with only minor additions necessary on a continuing basis, as source maps become available. Drafting continued through January. Preliminary copies of the complete map should be available late February/early March.

Computer analysis of ground truth of linear/fracture studies continued.

Screening and indexing of SL2 and SL3 data (Milestone 11) have been essentially completed. Attached is an inventory list of data products now on hand.

Quality evaluations of the SL2 and SL3 data have been summarized, as follows. SL2 S190-A data generally have minor cloud cover, but snow covers all high elevations. The snow in most cases degrades the informational quality of the photograph. SL3 S190-A photography generally has no snow, but cloud cover severely degrades the information content. The reproduction quality is generally good. The IR bands are useful for outlining bodies of water or large streams, but both IR bands are extremely grainy and generally lack useful spatial resolution. Color-IR gives excellent detail in distinguishing verdant from fallow fields, fields from grasslands, grasslands from forests, vegetation from nonvegetated rock and soil, rock from soil alluvium, and, to a lesser extent, rocks of different colors. Color photography best discriminates lithology on the basis of color. The red band is definitely best for general

geologic interpretation. The green band is good for discriminating snow only; it discriminates rock types poorly.

Structure is most easily seen in color, color-IR, and red bands. Optical enlargement makes it easier to see and map geologic features, but with a corresponding loss of synoptic view.

On 190-A photography one can discriminate buildings in Golden and 2-lane roads; one can identify Golden Reservoir (approx. 800 ft diameter) and I-70 (approx. 200 ft wide).

SL2 S190-B data has snow cover at high elevations that also degrades the information content of the photography. SL3 S190-B generally has excessive cloud cover. The color and color IR provide excellent detail and discrimination for both lithologic and structural features (as well as vegetation). To date, it has not been recognized that any of the S190-A photography yields geologic information that is not better seen and interpreted on S190-B color photos.

On the S190-B photography one can discriminate buildings in Leadville and fire roads around the town. One can identify tailings piles and color anomalies from 1-4 miles across, highways near Durango, and islands in Lake Electra (north of Durango) 300 ft in diameter.

Comparative evaluations of ERTS and Skylab data are being conducted in several areas in southwestern Colorado and southeastern Utah, along Track 34. A two-stage approach is being followed in some areas: (1) in the first, or training, stage, sequential photogeologic interpretations are made of ERTS, S190A and S190B data in "known" areas (either an area familiar to the photogeologist, or an area of good geologic maps, with the maps used in conjunction with the photos and imagery), and (2) in the second, or evaluation, stage, photogeologic interpretations are made in "unknown" areas (unknown to photogeologist) and interpretations are then checked with existing geologic maps. Preliminary results of the training stage suggest

that ERTS (red band) and S190A (red band) provide the same kinds of geologic information (mostly structural), with the only significant difference being that the much better resolution of the photographic system provides more detail. The introduction of photographic color in S190B photos causes a dramatic increase in the geologic information that can be extracted, mainly due to improved lithologic discrimination based on color differences and partly due to improved resolution.

Positive-negative masking was attempted to determine whether any band contains unique information. The process consists of overlaying, in registration, the positive transparency of one band with the negative transparency of another band on a light table. The theory is that any area of deviation from uniform gray will indicate a spectral difference. The materials used were 9x9 inch positive and negative transparencies of rolls 13 (photo-IR), 14 (photo-IR), 17 (red), and 18 (green), frame 17, SL2, S190-A, T.48, 11 June 73. Each positive was masked with the three other negatives, and each negative was masked with the three other positives, twelve combinations in all. These were observed, and notes were taken as to which combinations were best for isolating certain features. The significance of the observations remains to be determined.

Another comparative evaluation under way is a semi-quantitative evaluation of the capability of a photogeologist to discriminate different rock types, using aircraft, ERTS and Skylab photos and imagery. The study evaluates the mappability of 29 lithologic contacts, defined on 1:100,000 color photography, as a function of sensor, spectral pass band, season, sun angle and snow cover. The analysis of results should determine relationships of value to future geologists using remote sensing data.

Of the two summary papers submitted to U. Michigan for the 9th Symposium, one was accepted and one was rejected. The accepted paper has since been withdrawn and both have been submitted to, and accepted by, the U. Tennessee Space Institute for presentation at the 3rd Annual Remote Sensing of Earth Resources Conference in March.

Planned Activities for Current Month

The Bonanza Test Site geologic map should become available during February. It will be of great help in studying Skylab data in the central Colorado area, although its use will be diminished by the paucity of EREP data over that site.

Computer analysis of fracture data will continue. Correlation of ground truth analyses with the various types of linear analyses will begin.

Comparative evaluation studies will continue, with emphasis upon Track 34 areas.

Time will be devoted to preparation of the two papers to be presented at the Tennessee Conference.

Travel

There was no travel during January.

No travel is anticipated during February.

Outlook and Recommendations

With the recent termination of Skylab data gathering, it is apparent that the best total data coverage exists along Track 34, in southwestern Colorado. For this reason, it is recommended that some future research extend somewhat beyond the Colorado border, to include adjacent areas in Utah, and possibly New Mexico.

The failure to obtain any low sun-angle black-and-white photography is disappointing and is considered most unfortunate. However, small-scale aircraft LSAP was obtained, and significant studies with these photos can be conducted.

Because Skylab data have been, and are being received considerably later than originally anticipated, it is our intention to compile one interim technical report, rather than the two originally envisioned. Thus, Milestone 10 is considered void.

For future processing of S190 9x9 color positive transparencies, it is recommended that the photos be duped (a) so that the emulsion side is up, and (b) the frames are positioned such that direct stereo viewing is possible (conventions aren't all bad).



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